

Attachment 13

**Technical Memorandum – Evaluation of Sulfate
Concentrations in Five Monitoring Wells**

Technical Memorandum

Date: September 16, 2009

To: Jay Warzinski, Veolia Environmental Services

cc: Denny Marshall, RMT

From: Tom Koch and Steve Martin, RMT

Project No.: 00-20655.41

Subject: **Veolia Emerald Park – Response to Comment by Joe Lourigan, WDNR Regarding Increased Sulfate Concentrations in Site Monitoring Wells**

On August 27, 2009, Joe Lourigan, WDNR Hydrogeologist sent you an email that contained preliminary findings as part of his feasibility evaluation. The calculations that he included used historical groundwater data from monitoring wells at the Emerald Park facility. Joe's primary concern regarding the data was with regard to sulfate concentrations at five site monitoring wells (MW-8AR, MW-16A, MW-16B, MW-120A, MW-121A).

On September 2, 2009, Denny Marshall, Steve Martin, and Tom Koch spoke with you regarding Joe's concerns. At your request, RMT then followed up with Environmental Sampling Corporation (ESC) to obtain an electronic data file for the 5 wells and for leachate. The parameter evaluated included sulfate, sodium, and chloride which were chosen as primary indicators of a leachate problem such as a leak or spill.

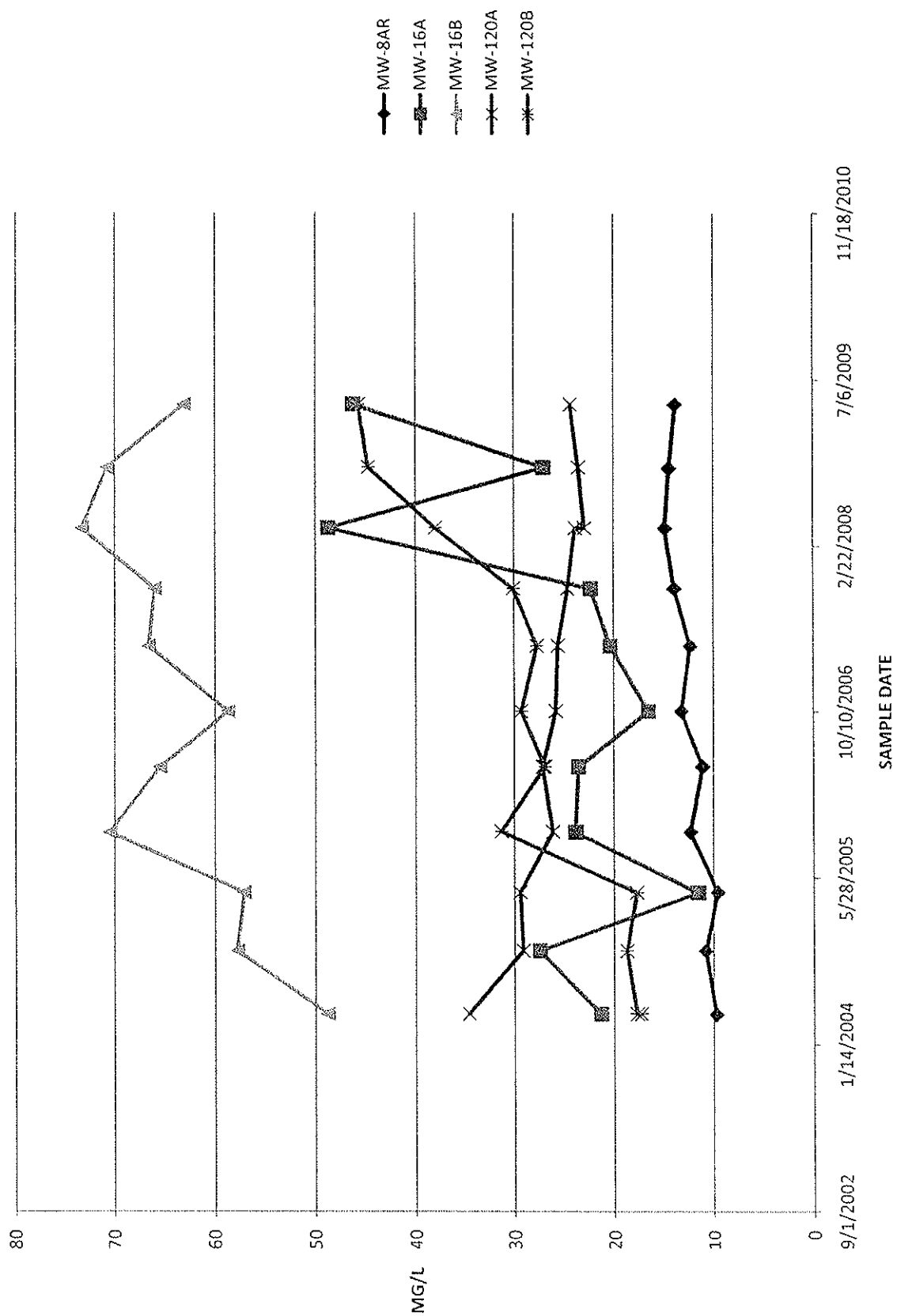
The data was promptly received from ESC and were then used to prepare time versus concentration graphs for each of the three parameters at the 5 wells. A separate graph was prepared for the leachate results for the three parameters. The six graphs are enclosed and have been used to prepare the following findings/conclusions.

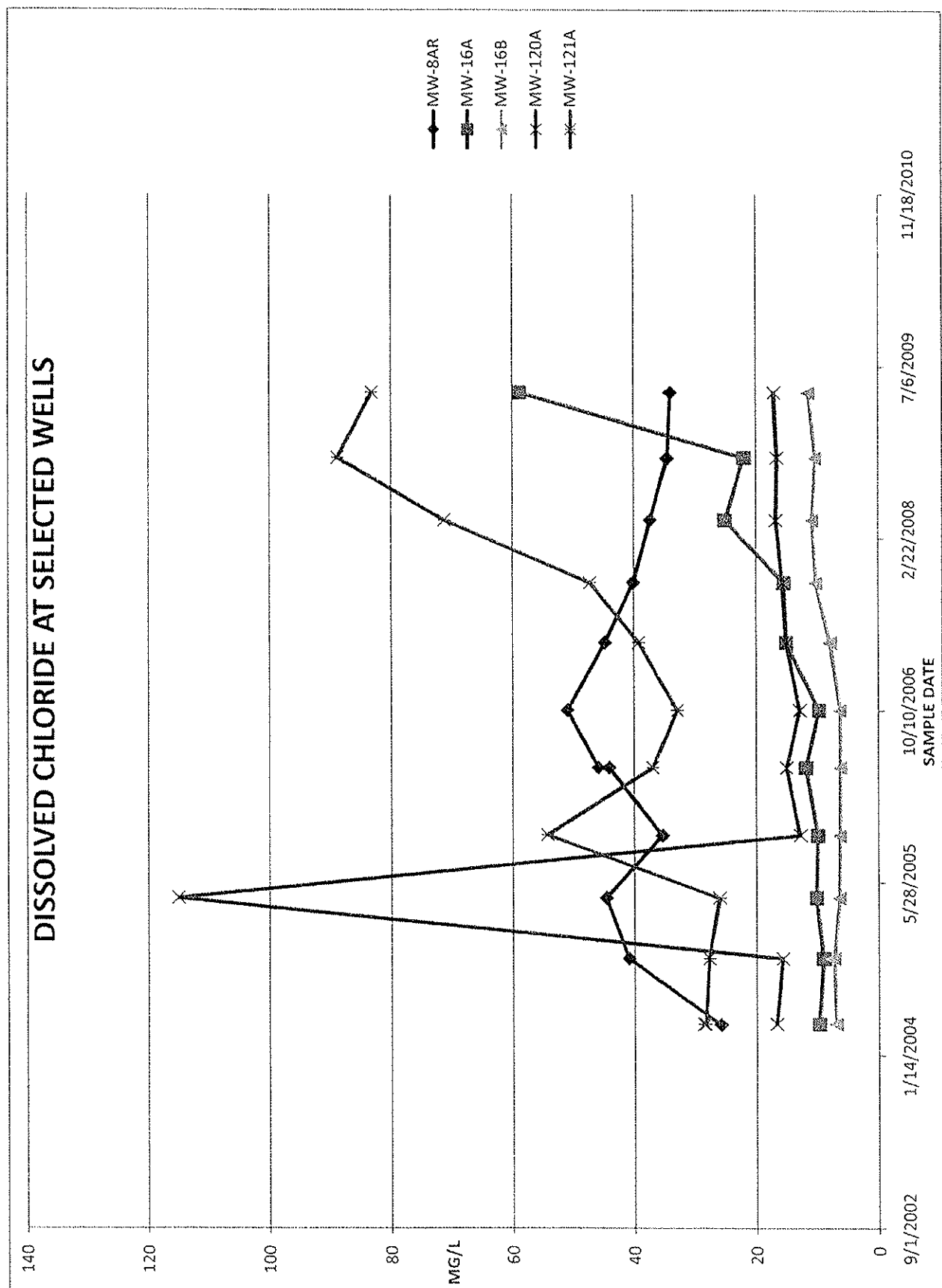
- Concentrations of chloride and sodium reported in leachate are generally an order of magnitude higher than those reported in the 5 monitoring wells.
- Concentrations of sulfate in both leachate and groundwater at the 5 wells are comparable.
- Because chloride, sodium, and sulfate are considered "conservative indicators", the presence of elevated levels of all three of these parameters in groundwater would be expected if a landfill-related leak or spill were to have impacted groundwater. The absence of increased chloride and sodium at concentrations comparable to those reported in leachate strongly suggests that the reported sulfate concentrations in groundwater are not due to a leachate-related phenomenon.
- Review of the graph depicting sulfate concentration in the 5 monitoring wells indicate the following:
 - Well MW-8AR – Sulfate concentrations at this well showed an increasing trend during 2005 and have generally remained stable since that time. This shallow water table well is located along the western edge of the original waste cell installed at the facility. It is located along a portion of the site where inward hydraulic gradients may result in groundwater flow toward the landfill rather than to the west.

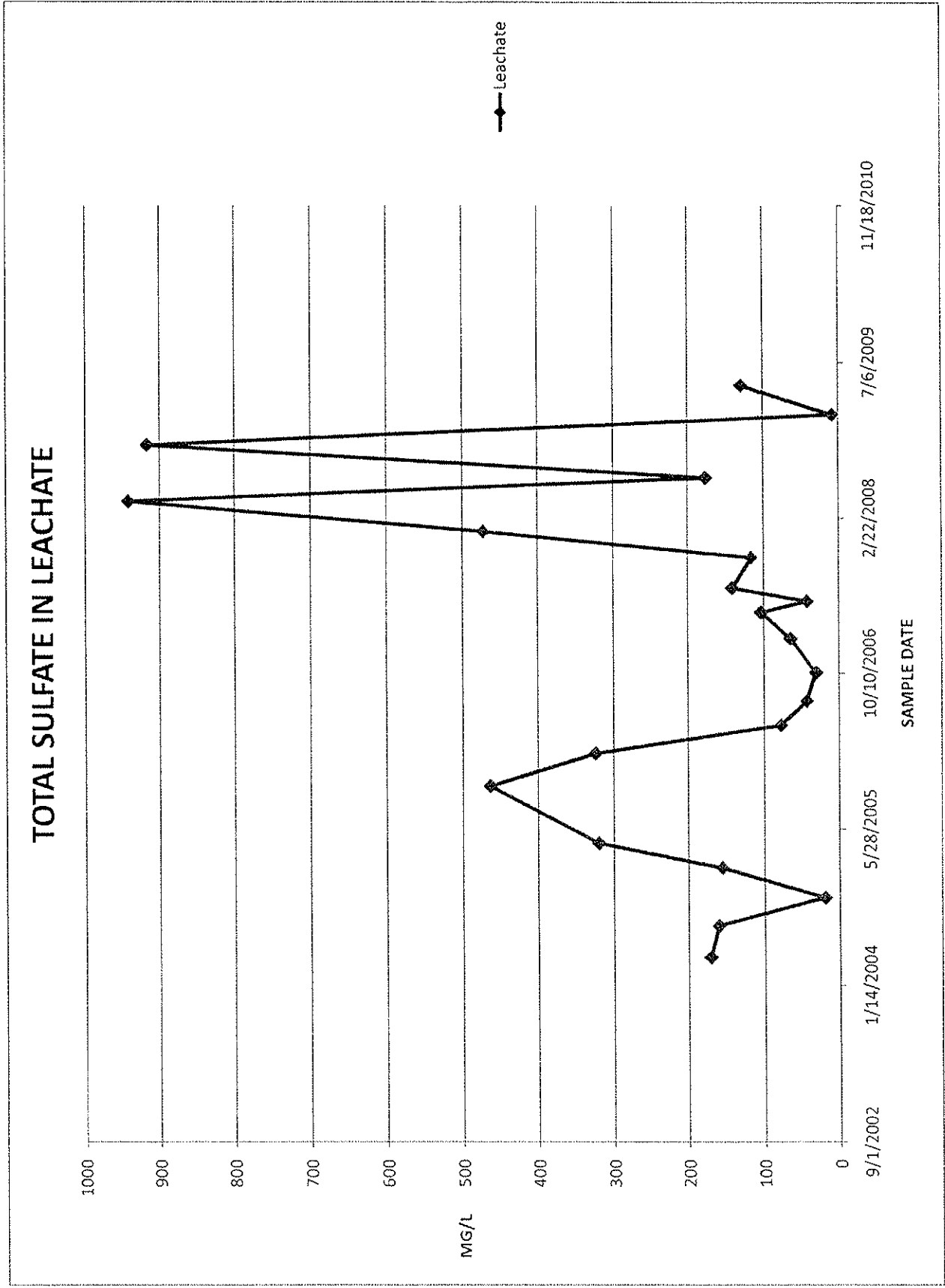
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- Well MW-16A – Sulfate concentrations at this well show an increase in concentration beginning in late 2007. This shallow water table well is located at the southwest corner of the original waste cell of the facility. A large stock pile of excavated clay from the construction of the Phase 6 waste cell nearly surrounds this location. Excavation of Phase 6 west began in the spring of 2007. It is quite possible that exposure of sulfate or sulfide containing minerals in the stockpiled soil could yield runoff during precipitation events that contains elevated sulfate that in turn could infiltrate into the soil in the vicinity of this well and cause the spike in concentrations.
- Well MW-16B – Sulfate concentrations at this piezometer have been slowly increasing since 2004, but are significantly less than those reported at MW-16A. Well MW-16B was installed as a nested pair with well MW-16A and is completed at a depth of approximately 40 feet below ground surface in a very tight (10^{-8} cm/second hydraulic conductivity) silty clay glacial till. The low groundwater flow rates in the clay at this depth preclude landfill leachate as a source and probably indicate that it may take a number of years to achieve geochemical stability for wells completed in the deeper clay.
- Well MW-120A – Sulfate concentrations in samples from this shallow water table well show an increase in 2005 but then generally have remained stable in the 300 mg/L to 400 mg/L range. Well MW-120A is up gradient of the Emerald Park Landfill facility. This suggests there are significant naturally occurring levels of sulfate in the local groundwater and that these concentrations can vary considerably seasonally and annually.
- Well MW-121A – This well is located side gradient of the facility and is completed as a shallow water table well. The concentrations of sulfate at this well have behaved in a manner very similar to those reported in upgradient well MW-120A.

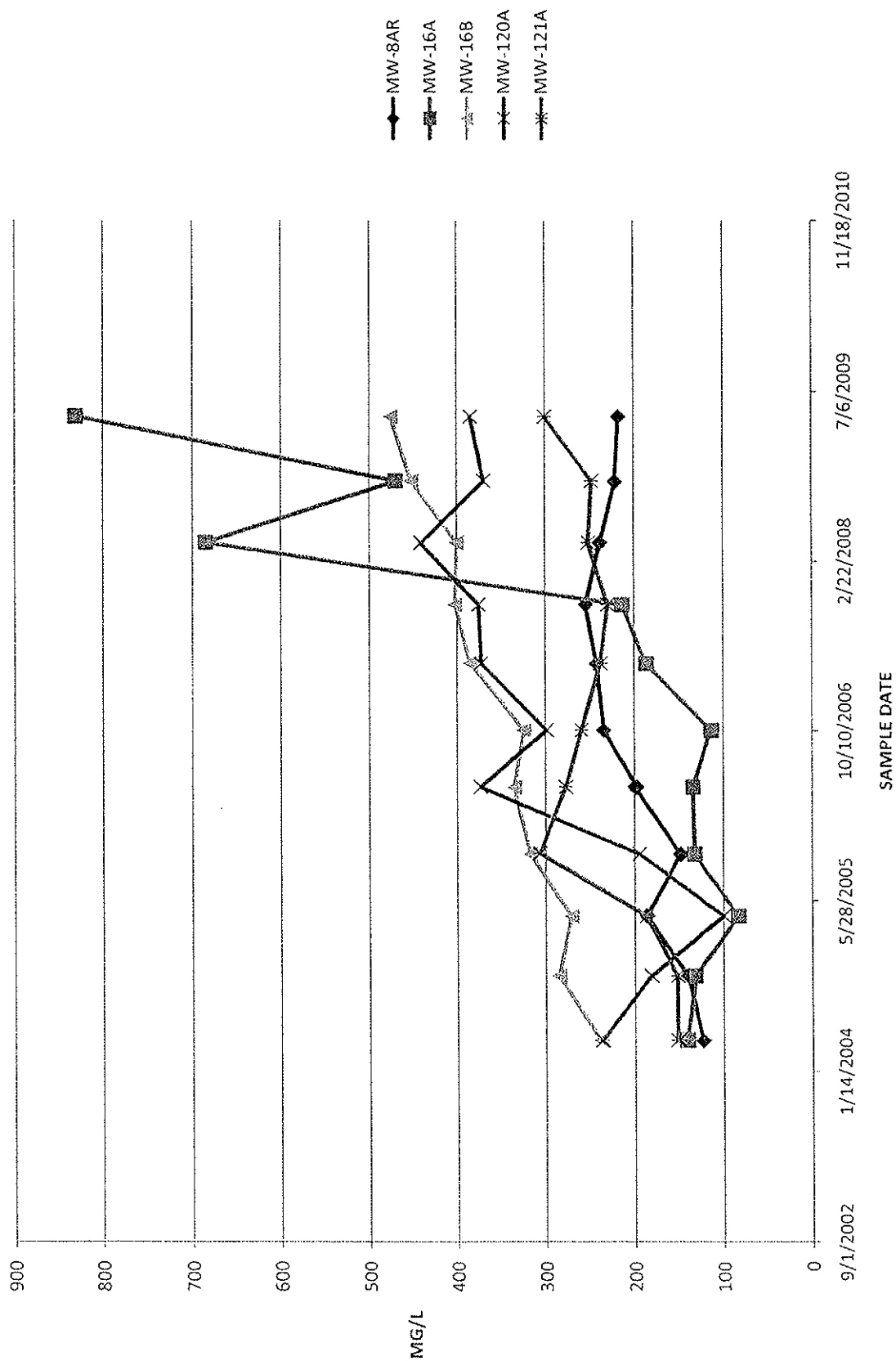
TOTAL SODIUM AT SELECTED WELLS

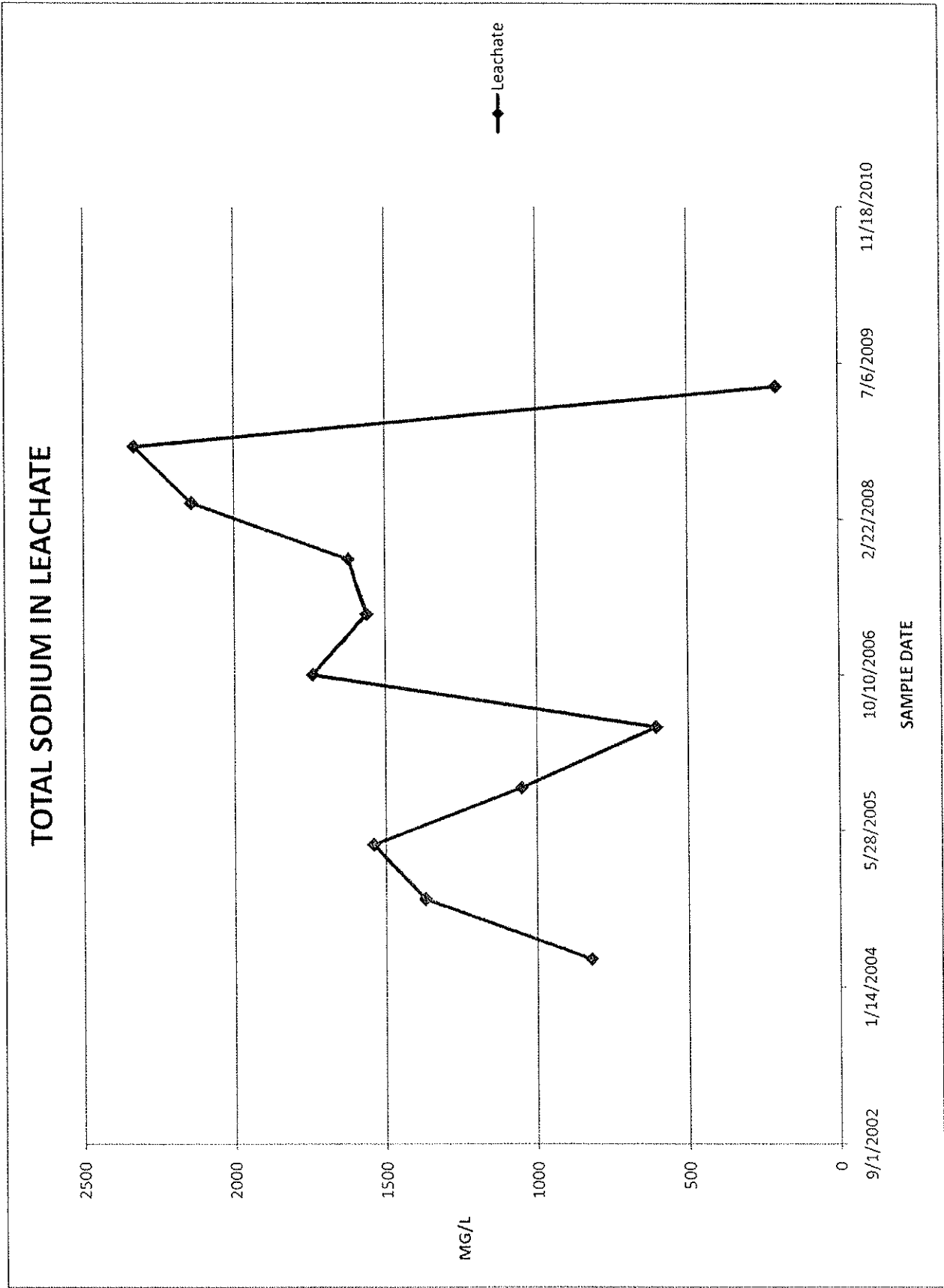






TOTAL SULFATE AT SELECTED WELLS





DISSOLVED CHLORIDE IN LEACHATE

